PATENT SPECIFICATION 983,413

DRAWINGS ATTACHED.

Inventors:—CHRISTHART ALBRECHT, WERNER OCHEL, and HANS PETER ISRAEL.

983,413

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COMPLETE SPECIFICATION.

Improvements in and relating to Uniting Members of Thermo-Plastic Synthetic Resin by Welding.

We, FELTEN & GUILLEAUME CARLSWERK AKTIENGESELLSCHAFT, a German Company of, Koln-Mulheim, Western German, do hereby declare the invention for which we pray that a Patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:—

It is known that thermo-plastic synthetic resins, for example polyethylene and polyvinyl chloride, can be united as by being welded under pressure provided they have been rendered plastic by heating. For this purpose it is known to heat thermo-plastic parts which are to be united by means of a stream of hot air or other gas, by passing electric heating current through resistance wires embedded in the parts or by applying direct heat by means of hot metal plates applied to the surfaces to be joined immediately prior to pressing those surfaces together. However, under many circumstances these known methods are not readily applicable, and particularly not in the case of the assembly of electric cable fittings, because these methods involve the use of apparatus which is not part of the normal equipment of a cable jointer. However, cable jointers are usually provided with blow lamps or other open flame producing apparatus. Efforts to weld thermo-plastic synthetic resins of the kind referred to, for instance polyethylene, by means of a naked flame have however failed to produce the desired result because a material such as polyethylene tends to oxidise readily in the naked flame and the oxide flame thus produced tends to impair the welding operation, such oxidisation may also occur when a material such as polyethylene is welded with the aid of a stream of hot air.

An object of this invention is to provide an improved method of uniting members of thermoplastics synthetic resinous material by bringing into mutual contact the parts which are to be welded together and applying heat thereto to produce a welded joint.

In accordance with the present invention a method of forming a welded joint under pressure between two members of thermoplastics resinous material, includes the steps of placing the surfaces of the members to be welded together in direct contact at the position of the joint, tightly bandaging said position and the adjacent portions of the two members with a bandage which resists expansion of the materials during subsequent heating of the members and is sufficiently heat resistant to remain effective throughout said heating, heating the bandaged portions of the members so that they soften and coalesce to form the weld, and cooling the portions to harden the weld. The heat may be applied by means of a flame, a stream of hot air or other gas, a heat radiating device or in any other appropriate manner. The invention resides essentially in the feature that the parts to be united are surrounded at the position of the weld with a form-retaining, sufficiently heat-resistant bandage prior to the application of heat. The bandage provides the pressure necessary to cause the hot thermoplastics material of the members to unite by offering a resistance to the expansion of the plastic material which occurs during the heating. Moreover, where the heating is effected by means of a flame or a stream of hot air, the bandage prevents

the plastics material from coming into direct contact with the oxidising hot air stream or the oxidising parts of the flame.

Prior to the application of the bandage to the parts to be united their mutually engageable surfaces are preferably degreased and roughened.

The bandage is preferably an elastic bandage, this having the special advantage that it will maintain the plastic material under pressure as the material contracts with cooling after the heat treatment. The bandage may consist of a foil of adequately heat-resistant synthetic resinous material for instance a fluorised high polymer. Suitably a transparent foil is used as this enables the operator to observe the conditions occurring beneath the bandage, namely the softening of the thermo-plastics material and the actual welding operation, so that he can control the duration and intensity of heat application accordingly.

A porous bandage may be used to particular advantage in that it will allow the plastic material which softens and expands during heating, to escape as by seeping through in small droplets to the exterior of the bandage and thus providing a simple way of observing the actual degree of softening of the material undergoing treatment. Moreover a porous bandage has the further advantage that any gas pockets which may be formed beneath it can escape freely to the exterior during the welding operation. The porous bandage is preferably formed of a fabric strip or tape. For not too high temperatures it is possible for instance to use a plain cotton tape. Preferably and particularly for welding by means of a naked flame, such a bandage is formed of woven glass tape or the like. Woven glass tape, for example, has adequate heat resistance for all practical purposes here involved and when made with a suitable weave it can be extremely elastic.

It is a feature of the invention that the improved method may be used for uniting as by welding the thermo-plastics sheath or sheaths of a cable or cables at its or their entry into the housing of a joint, termination or other cable fitting, which housing is also formed of thermo-plastic material.

Some preferred practical embodiments of the invention will be further described with reference by way of example to the accompanying diagrammatic sectional drawings, wherein: —

FIGURE 1 illustrates the butt welding of two solid members of equal dimensions;

FIGURE 2 illustrates the butt welding of two similarly dimensioned tubes;

FIGURE 3 represents a weld between a tubular body and a member inserted in the end of the tube;

FIGURE 4 illustrates another form of weld between a tubular body and a member inserted in an end thereof;

FIGURES 5 and 6 represent modified welded joints between similarly dimensioned tubes;

FIGURE 7 represents a cable jointing sleeve which can be united with plastic sheathed cables by the improved method; and,

FIGURE 8 represents a member of a cable sealing termination which can similarly be united with a plastic sheathed cable.

Figure 1 illustrates the use of the improved method to form a welded butt joint between two cylindrical rods 1 and 2 of equal radial dimensions and made from the same thermo-plastics synthetic resinous material, e.g. polyethylene. At the position of the weld the abutting parts are enclosed by a shape-retaining bandage 4 consisting of a close winding of a heat-resistant, porous tape of transparent synthetic resin foil or of woven glass tape, closely wound about the external surfaces of the parts 1 and 2 at and on both sides of the position of the weld. The degree to which the ends of the parts 1 and 2 which are to be welded together have softened may be observed through the transparent foil and/or by observing the formation of small droplets which have seeped through the porous bandage. After the weld has been allowed to cool and reset the bandage 4 may be removed or, if desired, it may be left in place to give the joint additional mechanical strength.

In Figure 2 there is shown a butt weld between two tubes 6 and 8 having similar radial dimensions. As in the previous figure there is shown the actual weld 3, the form-retaining bandage 4 and the heat supply flame 5. In order to prevent the plastic material escaping inwardly into the hollow interior 8 of the tubes at the position of the weld during the softening stage there is used an inner supporting ring 9, which bridges the actual welding position 3, being inserted into the ends of the tubes 6 and 8 before the bandage 3 is applied. The supporting ring 9 is made of material which will keep its shape and is resistant to pressure at the welding temperature. It may be made, for instance, of ceramic material, a metal or a hard and sufficiently heat-resistant synthetic resin.

Figure 3 shows the welding together of two parts of relatively different thickness namely a cylindrical rod 10 inserted as a close fit in the end of a tube 11. In order to provide a continuous smooth support for the shape retaining bandage 4 and also to permit the bandage to extend beyond the inner end face of the tube 11, the diameter of the cylindrical rod 10 adjacent to this end of the tube 11 is increased to the external diameter of the tube by additional windings 12. These

additional windings may be made of any suitable material which need not weld with the material of the parts 10 and 11. Like the bandage 4 it may be removed after the welding operation when the welded joint has cooled and hardened, or it may be left in place to give additional mechanical strength.

In Figure 4 there is shown a somewhat similar joint between a cylindrical rod 10 which has an exterior diameter appreciably less than the internal diameter of the tube 11. In this case there is applied to the end of the rod 10 a member formed by a length of appropriately dimensioned tubing 13 made of the same or a similar thermo-plastics material as the part 10 or 11. Instead of the tubing 13 a bandage winding may be used of the same dimensions as the tubing 13. The additional member 13 will have an external diameter corresponding to the internal diameter of the tube 11 and may be caused to unite by welding to the parts 10 and 11 during the main joint-forming operation. However, where the dimensions of the two parts 10 and 11 differ considerably the additional member 13 may be welded thermally to the cylindrical rod 10 in a separate operation prior to the actual welding operation which secures the rod 10 to the tube 11. The end of the rod 10 which is thus effectively increased in diameter by the application of the winding or tube 13 is then inserted into the tube 11 and welded thereto by the operation described with reference to Figure 3. In both instances it is preferable to use the supplementary winding 12 to build up the diameter of the smaller rod 10 adjacent to the welding position prior to applying the shape-retaining bandage 4.

Figures 5 and 6 represent two modified methods of welding two tubes 14 and 15 which have substantially the same radial dimensions. In this case the tubular ends to be jointed together are appropriately shaped to fit one inside the other. For instance, as indicated in Figure 5 the end of one tube 14 is reduced in diameter to form a step with an inner cylindrical portion 16 or spigot, and the end of the other tube 15 is shaped to form a recessed portion 17 or socket into which the portion 16 is inserted. In the arrangement shown in Figure 6 the end of tube 14^1 is tapered at 18 and the end of the other tube 15^1 is formed with an inversely tapered recessed portion 19, the two ends being mated with one another as shown. The welding operation is then effected in the manner already described with reference to Figure 2. In each case an internal supporting ring 9 may be used as described above.

In the assembly of cable accessories such as joints and sealing terminations the method of the invention can be used to connect the external housing or casing to the end of the cable or cables which extend thereinto. The end or ends of the housing or casing into which the cable is to be inserted may be formed internally with a number of stepped portions of successively reduced diameter to render them readily adaptable to the diameter of the cable sheath with which they are to be used. The end of the casing or housing 20 will then merely have to be severed at a step determined by the diameter of the cable. For instance, Figure 7 illustrates a straight through joint sleeve 20 the ends of which are reduced in steps 21 and which can be severed on any one of the lines 22 as determined by the cable diameter. Figure 8 illustrates the exterior member 23 of a cable sealing terminal which at the cable entry is similarly formed with stepped portions 21 adapted to be severed on the lines 22. These members 20 and 23 are made of thermoplastics material which is similar to the external covering or sheathing of the electric cables or cable with which they are to be used. The welding of the members to the cable sheaths may be performed in any of the manners described with reference to Figures 1 to 6.

WHAT WE CLAIM IS:—

1. A method of forming a welded joint under pressure between two members of thermoplastics resinous material, including the steps of placing the surfaces of the members to be welded togther in direct contact at the position of the joint, tightly bandaging said position and the adjacent portions of the two members with a bandage which resists expansion of the materials during subsequent heating of the members and is sufficiently heat resistant to remain effective throughout said heating, heating the bandaged portions of the members so that they soften and coalesce to form the weld, and cooling the portions to harden the weld.

2. The method claimed in claim 1, in which the bandage is elastic.

3. The method claimed in claim 1, in which the bandage is made of glass.

4. The method claimed in claim 1 or claim 2, in which the bandage is porous.

5. The method claimed in claim 1, claim 2, claim 3, or claim 4, in which the members abut one another at the position of the joint.

6. The method claimed in claim 1, claim 2, claim 3, or claim 4, in which the members overlap one another at the position of the joint.

7. The method claimed in claim 6, in which a spigot and socket connection is formed between the members at the position of the joint.

8. The method claimed in claim 6, in which one member is provided adjacent the position of the joint with a second heat-resistant bandage the exposed surface of

which is continuous with the outside surface of the other member.

9. The method claimed in claim 6 or claim 8, in which one member is formed at the position of the joint with an element made of the same material and a close fit within the other member.

10. The method claimed in claim 9, in which the element is built up from superimposed turns of a helical wound strip.

11. The method claimed in any one of claims 1 to 5, in which one of the members comprises a housing or casing.

12. The method claimed in any one of the preceding claims, in which one of the members comprises a cable sheath.

13. The method claimed in any one of the preceding claims, in which an internal supporting ring is mounted inside the portions of the two members at the position of the joint.

14. A method of uniting, as by welding, members of thermoplastic synthetic resin, substantially as herein described with reference to Figure 1 of the accompanying drawings.

15. A method of uniting, as by welding, members of thermoplastic synthetic resin, substantially as herein described with reference to Figure 2 of the accompanying drawings.

16. A method of uniting, as by welding, members of thermoplastic synthetic resin, substantially as herein described with reference to Figure 3 of the accompanying drawings.

17. A method of uniting, as by welding, members of thermoplastic synthetic resin, substantially as herein described with reference to Figure 4 of the accompanying drawings.

18. A method of uniting, as by welding, members of thermoplastic synthetic resin, substantially as herein described with reference to Figure 5 of the accompanying drawings.

19. A method of uniting, as by welding, members of thermoplastic synthetic resin, substantially as herein described with reference to Figure 6 of the accompanying drawings.

20. A method of uniting, as by welding, members of thermoplastic synthetic resin, substantially as herein described with reference to Figure 7 and 8 of the accompanying drawings.

21. Two members between which a joint is formed by the method claimed in any one of the preceding claims.

FORRESTER, KETLEY & CO.,
Chartered Patent Agents,
Jessel Chambers, 88-90 Chancery Lane,
London, W.C.2,
and
Central House, 75 New Street,
Birmingham 2,
Agents for the Applicants.

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Fig. 1.

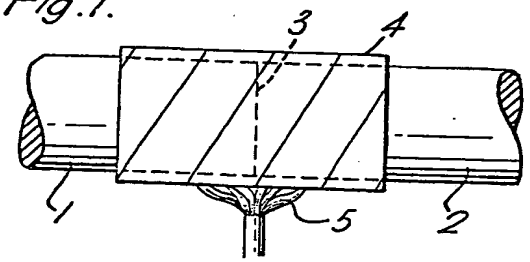


Fig. 2.

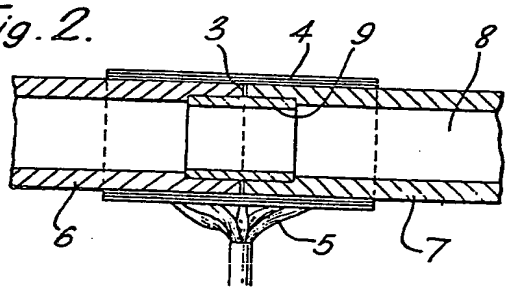


Fig. 3.

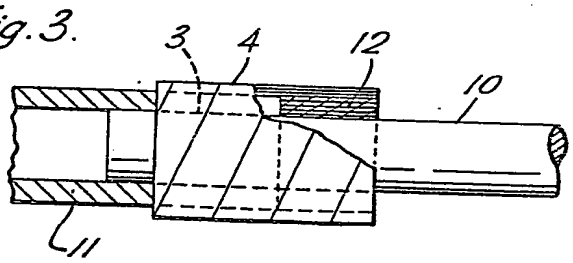
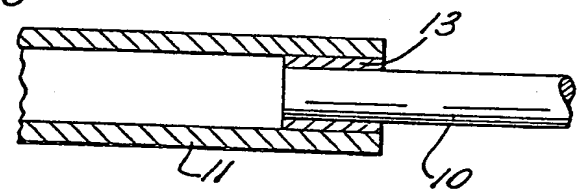


Fig. 4.



983413 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2

Fig.5.

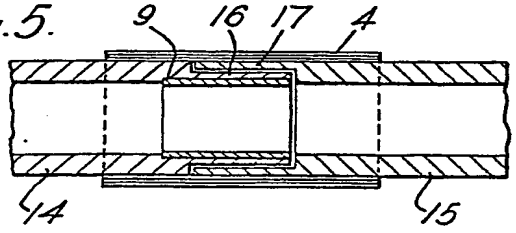


Fig.6.

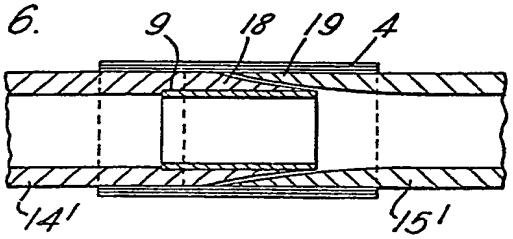


Fig.7.

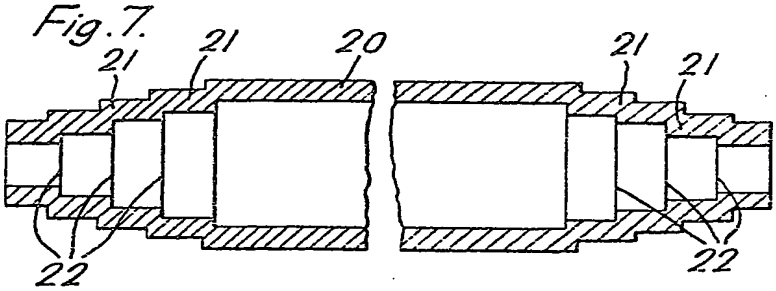


Fig.8.

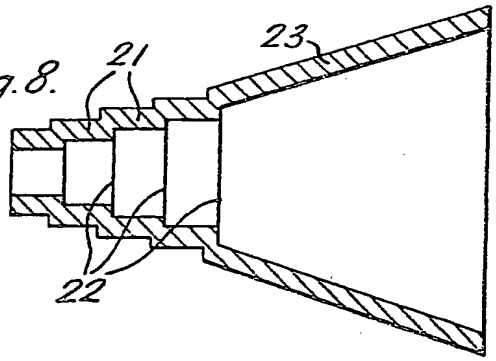


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Fig.1.

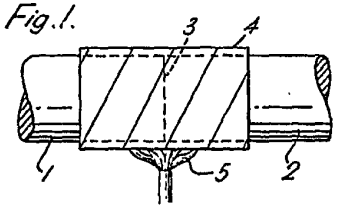

Fig.2.

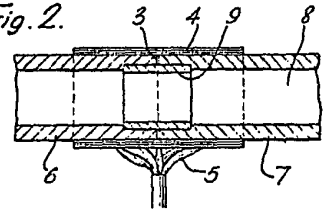

Fig.3.

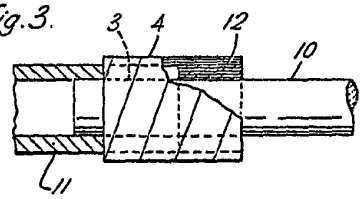

Fig.4.

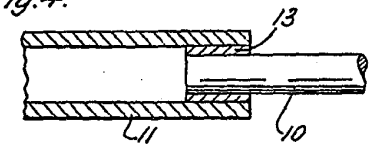

Fig.5.

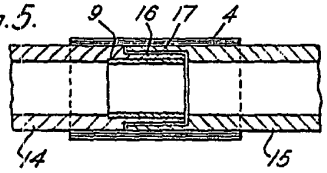

Fig.6.

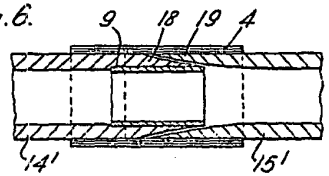

Fig.7.

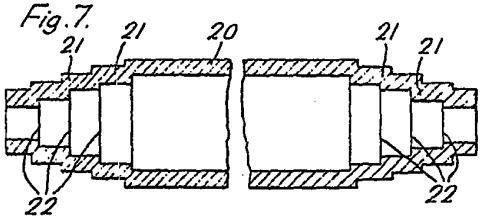

Fig.8.